THE BACTERIAL EXAMINATION OF SAUSAGES AND ITS SANITARY SIGNIFICANCE.

WILLIAM E. CARY,
Department of Hygiene and Bacteriology, University of Chicago.

DURING the last decade considerable attention has been directed to the question of pure food and its sanitary distribution not only by reason of government inspection, but also because of an increasing public demand for pure food. For many years German officials have recognized the possible danger to public health from improperly prepared or handled sausages. French and English sanitarians have also recognized the importance of this question and have conducted some experimental work to ascertain the extent of the danger; but in the United States there seems to have been little or no work reported on sausages.

The nature of sausages and the finely ground meats composing them have led to much speculation on the part of consumers as to the quality and kinds of meat that might be used. Sausages are popularly reputed to contain anything from good pork and beef down to horse, dog and cat meat, as well as bread, flour, and other starchy substances. The presence of partially decayed meat may be effectively covered up by high seasoning, salting and smoking as well as by preservatives. Probably the most common adulterant added to sausages is starch either in the form of old bread or corn starch. Ostertag* reports that in Germany it is customary to add 2 per cent. of starch to all "brühwurst" and even as high as 5–8 per cent. The manufacturers prefer not to consider this as an adulterant, but claim that it is added to bring the "combining power" of the sausage to a proper point so that less shrinkage will occur in cooking and more food value be retained. The custom of rapidly fattening hogs is said by Ostertag to produce a fat that cooks away more than does that in hogs more slowly fattened, and the small amount of starch added only restores the swelling capacity of the muscle albumin and is hence not considered an adulterant.

The use of uncooked and visceral sausages, which are especially likely to contain pathogenic bacteria, has made the sausage problem in Germany of more importance than it is elsewhere. Lungs, spleen, liver and brains are often used in German sausages in large amounts. It is well known that pathogenic organisms are particularly likely to occur in the spleen and liver, while the keeping quality of the sausages are at the same time reduced by their use.

Savage† classes the danger from sausage poisoning under three heads:

1. From toxins produced by the ordinary bacteria of decomposition. This poisoning is generally not severe.

2. From infection with members of

* Ostertag, Robert. Handbook of Meat Inspection, 1904.

† Savage, W. G. *Med. Press and Circ.*, London, 1908, n.s. 86, p. 167.

the enteritidis group. This he considers a real source of danger to public health that is not completely obviated by either cooking or salting. In an experiment with sausages containing B. enteritidis, even a fairly well cooked sample contained the living bacteria in its interior. A 10 per cent. salt solution was found to kill the pathogens very slowly and six days were required to render the sausage sterile by this means.

3. Poisoning due to the toxins of B. botulinus. Outside of Germany, where it is present in visceral sausages, B. botulinus is rarely found, and even there it is much less common than formerly.

The number of bacteria in ordinary sausage varies greatly and very little significance can be attached to mere numbers. In well cooked, smoked sausages v. d. Slooten[1] found the number of bacteria very low and in one plating the sausage was sterile. He found that the diminution in the number of bacteria was greatly influenced by the drying and smoking process. One raw sausage sample became sterile after a week's smoking. In highly seasoned sausages many kinds of bacteria are unable to survive. The cocci are more resistant to salt and are consequently found in relatively larger numbers in highly seasoned meats. Even if very large numbers of bacteria are present, the greater part may not be unwholesome. No definite standard of bacterial content has been accepted which must not be exceeded if a sausage is to be considered wholesome. Savage believes that little importance can be attached to the number of bacteria present but considers the presence of intestinal bacteria of great significance. v. d. Slooten, nevertheless, sets the limit at 2,000,000 per gram and considers all containing over that number unfit for use unless an examination shows them to be harmless. Weinzirl and Newton[2] from their work on hamburger steak have suggested that 10,000,000 bacteria per gram be taken as a standard for a sanitary meat. They found, however, that this standard did not correspond in all cases with the "organoleptic" test.

The presence of B. paratyphosus and B. enteritidis in sausages has been reported from time to time by various observers. Rommeler[3] has recorded the work of Hübener who examined 100 samples of sausages and found B. paratyphosus six times. Mühlens, Dahm, and Fürst[4] fed 57 samples of all kinds of meat to 138 white mice and concluded that 24 of the samples contained B. paratyphosus and 13 contained B. enteritidis. Discredit has been thrown on the value of this work by more recent investigation showing that auto-infection may occur in mice with members of the enteritidis group especially where the normal nutrition of the animal is disturbed. In his own researches on visceral sausages Rommeler found B. paratyphosus in 8 out of 50 samples. Komma[5] examined 102 samples of sau-

[1] v. d. Slooten. *Inaug. Diss.*, Bern., 1907. (Cited by E. Roth in *Cent. f. Bakt.*, 1 Abt. Ref. 43, p. 403.)
[2] Weinzirl and Newton. Am. Jour. Pub. Health, 1914, 4, p. 413.
[3] Rommeler. *Cent. f. Bakt.*, 1 Abt. Orig., 1909, 50, p. 501.
[4] Mühlens, Dahm and Fürst. *Cent. f. Bakt.*, 1 Abt. Orig., 1908–09, 48, p. 1.
[5] Komma, Franz. *Cent. f. Bakt.*, 1 Abt. Orig., 1910, 55, p. 1–14.

sage and found 30 of them to contain B. paratyphosus. He believes that their presence is due to uncleanliness in manufacture as these organisms are found normally in the intestinal tract of the animals employed. Hübener[1] believes that meat poisoning from B. paratyphosus from healthy animals is questionable. In 65 cases of meat poisoning with positive bacterial findings he reports 36 due to B. paratyphosus and 29 to B. enteritidis. The toxin given off was so great that in some cases 2 cc. of bouillion in which they were grown, when injected into a mouse, caused death. Heinemann[2] reports an instance where two people were poisoned with B. paratyphosus from cooked sausage and one from raw meat obtained from the same butcher. Schmidt[3] found in healthy animals (hogs and horses) B. paratyphosus present that were not pathogenic. It should be mentioned, however, that the large number of cases in which members of the enteritidis group have been found by German investigators and called B. paratyphosus or B. enteritidis may be due to classification based on morphology and cultural characteristics alone. It is a well-known fact that many organisms thus classified cannot finally be identified as such by the agglutifiation test.

B. coli has been found almost constantly in sausages but little importance has been attached to its prevalence by most observers. Savage examined 12 samples of home ground sausages and found B. coli present in every case in numbers varying from 10–45,000 per gram. In 92 per cent. there were more than 100 per gram. He believes that they multiply rapidly in the sausages. In order to determine whether these bacteria were introduced in the skin used for a casing for the sausage, Savage examined twelve samples of casings, commercially prepared with salt brine, and found all to be free from B. coli. If B. coli survives this pickling process, he believes that the danger from pathogens surviving may be real. Maurel[4] has constantly observed the presence of a diplococcus in the sediment from apparently good sausages which produced a marked loss of weight in injected rabbits. By lowering the resistance through the introduction of small amounts of mercuric chloride, the loss after the injection of the diplococcus became much more marked. The organism could be found abundantly in the blood of the rabbits after forty-eight hours. The loss of resistance brought about by the mercuric chloride is ascribed by Maurel to a partial destruction of the phagocytic power of the leucocytes. He draws the inference that this diplococcus might be harmless to healthy individuals but under conditions of lowered resistance, from whatever cause, might become pathogenic.

The viability of organisms in sausages has been studied by different observers. Maurel[5] sterilized the surface of sausages, in bulk and slices of bologna, in an autoclav, tested for sterility and then infected them with colon and typhoid bacilli. Both organisms seemed to increase and main-

[1] Hübener, E. Jena (Gustav Fisher), 1910.
[2] Heinemann. *Zeitschr. f. Med. Beamte*, 1911, Beil. No. 1, p. 1.
[3] Schmidt, P. *Münch med Wochenschr*, 1911, p. 563.
[4] Maurel, E. *C. r. Soc. de Biol.*, 1911, 70, p. 617.
[5] Maurel, E. *C. r. Soc. de Biol.*, 1910 69, pp. 513, 574.

tain their activity for at least 24 hours and often for many days when placed in Petri dishes and kept at 35°C. B. typhosus, he found, died off slightly sooner than B. coli.

Very few detailed accounts of the methods used for the bacterial examination of sausages are to be found in the literature. Rommeler and Komma used essentially the same methods. The instruments and surface of the sausage were sterilized in hot oil, the sausage carefully opened and a cube-shaped portion taken from the inner part of the sausage and placed in a deep Petri dish. Sterile salt solution was poured over in which the meat was thoroughly emulsified. A knife point of papain, previously sterilized in a dry oven in a Petri dish at 130° C., was added and the emulsion incubated for two days at 37°C. By this time the sausage was digested and a drop of the liquid of a proper dilution was spread over a brilliant-green-picric-acid plate and also over a Conradi-Drigalski plate. The developing colonies that resembled the intestinal bacteria were then transferred and identified in the various media and by the agglutination test. Savage sterilized the outside of the sausage by cauterization, opened it sterilly and took about two grams, weighed accurately, into a bottle with a rubber stopper containing 20 cc. of sterile water. After thorough mixing, various quantities of the emulsion were added to lactose-bile-salt media and the resulting colonies transferred and identified in the various media. Weinzirl and Newton ground samples of meat (hamburger steak) with sterile sand in a mortar and obtained an emulsion in salt solution from which the necessary dilution were made. One cc. of the dilutions was plated on 1.5 per cent. agar with a reaction of 1.5 per cent. acid and incubated at 20°C. They made no effort to isolate intestinal bacteria. v. d. Slooten believes that animal experimentation is of great value in determining the wholesomeness of sausages. He used a water extract of the sausage and injected subcutaneously into mice, guinea pigs and rabbits. With good sausage no effect should be noticed on the animal.

The purpose of the work described in this paper is:

1. To determine the number of bacteria present per gram of meat and to find the factors influencing it.

2. To determine the prevalence of fecal or pathogenic organisms in the sausage.

3. To determine the presence of adulterants.

4. To determine the prevalence of the use of preservatives.

5. To find the influence of sanitary marketing on the bacterial content.

6. To determine the effect of cooking on the bacterial flora.

General Technique.—The thirty-four samples of pork sausage examined have been obtained under the usual conditions found in the meat markets of Chicago and have been brought directly to the laboratory for examination. Each shop has been scored on the basis of 100 per cent. on the sanitary surroundings, method of handling, exposure of meat, light and ventilation, cleanliness of workers and refrigeration at the time the sample

was taken. At the laboratory the utensils and the outside of the sausage were sterilized, the sausage being rotated in the gas flame for about fifteen seconds. The sausage was then carefully cut open with a sterile knife and three or four grams of the meat taken from the interior and accurately weighed. This was then emulsified thoroughly in an Erlenmeyer flask by means of a sterile glass rod with 100 cc. of sterile water. From this emulsion dilutions were made to 1–1,000,000. For the total count twenty-four hours' incubation at 37°C. and forty-eight hours' incubation at 20°C. on 1 per cent. glycerin agar neutral to phenolphthalein was used. For distinguishing roughly the intestinal bacteria, Endo medium +.5 was employed. Besides plating on these media, 1 cc. of each dilution has been added to a 1 per cent. dextrose broth fermentation tube to determine the number of gas-forming organisms. One cc. of the first two dilutions was added to each of three tubes of Torrey's medium* +.2 to +.5, containing respectively .15, .2, and .25 cc. of a 1 per cent. brilliant green solution in water. Forty-eight hours after plating, the colonies that on Endo looked like B. coli, B. paratyphosus, B. typhosus, B. fecalis, Proteus or Streptococcus were transferred to Russell's medium, and, in case of characteristic growth, each variety was studied morphologically in hanging drops and stains and transferred to litmus milk, gelatin, and 1 per cent. dextrose, lactose, and saccharose broths for further observation and final identification. Agglutination tests with paratyphoid and enteritidis serum were employed on seven of the nine organisms which apparently belonged to the enteritidis group. After twenty-four hours' incubation at 37°C., Endo medium plates were made from each of the brilliant green tubes and any developing colonies treated as from the original plating on Endo. At the end of forty-eight hours the fermentation tubes were examined and any sediment leading to suspicion was examined in stained preparations for streptococcus. In instances where B. coli failed to develop on Endo from the original plating, any dextrose tubes containing gas were plated and an effort made to isolate B. coli. By these methods B. coli was isolated from thirty of the thirty-four samples examined. Samples 13, 25, 29 and 31 showed no B. coli by any of these means. Sixty-six per cent. of the samples contained over 100 B. coli per gram of meat. In one instance, Sample 7, which was home-ground and not put up in link form, there were 38,000 B. coli present per gram. The total bacterial count both at 37°C. and 20°C. varied widely, the former from 2,500 per gram in Sample 33 to 1,538,000 per gram in Sample 9, the average being 158,000; the latter from 650 per gram in Sample 10, which was taken directly from the farm as soon as made, to 200,000,000 per gram in Sample 1, the average for all samples being 9,018,000. Little value can be attached to these averages in so wide a variation and with so few samples examined. In Table 1 a tabulation of the count from each sample is re-

*Torrey J. C. *Jour. Inf. Dis.* 1913, 13, pp. 263–272.

TABLE 1.

Sample number.	Score of shop.	Method of marketing.	Bacteria per gram meat at 37°C. 24 hours.	Bacteria per gram meat at 20°C. 48 hours.	B. coli present per gram.	Gas formers with dextrose per gram.	Corn starch per cent.	Sulfites.	Kinds of bacteria isolated.
1	86	Small link, bulk	910,000	200,000,000	+*	+*	2	Not tested	B. coli
2	89	Small link, carton	807,000	8,000,000	+*	+*	0	"	B. coli
3	84	Home-made, bulk	4,600	2,300,000	300	250	0	"	B. coli, B. fecalis
4	79	Home-made, bulk	4,300	72,000	1,600	4,000	3	"	B. coli, M. tetragenus
5	87	Small link, carton	8,800	144,300	850	3,500	0	"	B. coli, B. fecalis, Prot. vulgaris
6	86	Small link, carton	369,000	2,181,000	15,000	37,000	2	"	B. coli, Streptothrix, B. intestinalis
7	81	Home-made, bulk	131,600	6,269,000	38,000	31,000	3	"	B. coli, B. paracoli
8	88	Small link, bulk	58,800	16,755,000	3,600	4,000	6	"	B. coli, Prot. vulgaris, B. fecalis
9	86	Small link, carton	1,538,400	282,800	950	4,000	0	"	B. coli, B. fecalis, yeast
10	Farm	Direct from farm, bulk	47,000	650	200	350	0	"	B. coli
11	89	Home-made, bulk	27,000	6,758,000	7,400	31,000	0	"	B. coli
12	82	Small link, carton	271,500	271,500	1,500	300	0	"	B. coli, Prot. vulgaris
13	82	Small link, carton	35,900	1,900,000	0	0	0	"	B. coli anærogenes, B. fecalis
14	81	Small link, bulk	3,700	1,962,000	31	310	6	"	B. coli, Streptococcus
15	82	Small link, bulk	119,000	562,000	2,500	41,320	0	"	B. coli, B. paracoli, Prot. vulgaris
16	87	Small link, bulk	19,700	7,561,000	900	4,000	5	"	B. coli, Streptococcus, yeast
17	85	Small link, bulk	6,300	2,200,000	350	5,000	3	"	B. coli, B. paracoli,† yeast
18	89	Small link, home-made	2,600	641,400	34	340	0	"	B. coli, Prot. vulgaris, B. fecalis

TABLE 1—(*Continued*).

Sample number.	Score of shop.	Method of marketing.	Bacteria per gram meat at 37°C. 24 hours.	Bacteria per gram meat at 20°C. 24 hours.	B. coli present per gram.	Gas formers with dextrose per gram.	Corn starch per cent.	Sulfites.	Kinds of bacteria isolated.
19	83	Small link, bulk	646,700	36,800	382	2,500	0	Not tested	B. coli, Prot. vulgaris fluorescens, yeast
20	83	Home-made, carton	16,100	2,200	28	280	0	"	B. coli, Prot. vulgaris
21	86	Small link, bulk	30,000	20,482,000	180	30,000	5	"	B. coli, B. paracoli,† B. fecalis, yeast
22	74	Large link, bulk	12,500	5,600	1,000	24,000	5	+	B. coli, Prot. vulgaris
23	71	Small link, bulk	20,000	56,700	700	3,500	12	+	B. coli, Prot. vulgaris
24	59	Large link, bulk	39,600	773,600	57	286,000	0	0	B. coli, Staph. aureus, B. paracoli.†
25	77	Large link, bulk	4,000	36,900	0	3,000	8	+	B. coli
26	60	Small link, bulk	10,400	4,467,500	155	2,600	4	0	B. coli, Prot. vulgaris
27	55	Large link, bulk	33,000	1,568,000	10,000	20,000	8	+	B. coli
28	71	Home-made, bulk	24,400	3,397,000	24	240	0	+	B. coli, Prot. vulgaris B. paracoli† Staph. aureus
29	64	Large link, bulk	5,340	3,353,000	0	340	5	0	Prot. vulgaris, B. paracoli†
30	74	Large link, bulk	75,000	2,211,000	182	2,000	4	+	B. coli, Streptococcus, yeast
31	80	Small link, bulk	10,800	100,000	0	2,600	10	+	Streptococcus, B. fecalis, yeast
32	89	Small link, carton	33,100	2,108,000	117	23,400	?	0	B. coli
33	75	Small link, bulk	2,500	7,873,000	83	8,300	6	+	B. coli, Streptococcus, B. paracoli†
34	75	Large link, bulk	3,700	1,823,000	92	1,840	4	0	B. coli, Staph. albus, B. paracoli†

Samples 1–21 from markets in good residence district; 22–34 from poorer markets.

*Exact record not taken.

†Agglutination negative with paratyphoid and enteritidis serum.

corded. Samples 1–21 were all taken from shops in a good residence district of Chicago, near the University of Chicago, that are above the average from a sanitary viewpoint, while Samples 22–34 were taken from poorer, less sanitary districts on the west side of the city. These shops were in most cases highly unsanitary, yet the counts on samples from these unsanitary shops showed no increase over those on samples from shops scoring higher. In fact the average count of the samples from the more sanitary shops at 37°C. was 241,000 per gram against 24,000 per gram from the west side shops. The 20°C. count showed an average of 13,280,000 against 2,133,000 from the respective regions. This may indicate that the sulfite found in many of the west side samples was an important factor, either in the prevention of the bacterial multiplication or in the destruction of the bacteria originally present, resulting in the lower count. In the west side samples free from sulfites, however, there seemed to be no constantly greater number of bacteria present than there were in the samples containing sulfites.

Influence of Casings.—An effort was made to determine the influence of the sausage casings on the bacterial count. For this purpose the scrapings from the interior of the casings from seven samples, 13–19, were run parallel with the interior contents of the same sausage. The sausages were split open with a sterile knife, the contents taken out and the inside of the skin scraped. The seven samples run in this manner showed the following results:

1. In five of the seven samples the 37° count of the scrapings at twenty-four hours was greater than that of the interior content.

2. In four of the seven samples the 20° count of the scrapings was greater.

3. In five of the seven samples the 37° count of B. coli was greater in the scrapings.

4. In one sample no B. coli was found in the scrapings while there were a few in the interior of the sausage.

5. In one sample an intestinal organism related to the enteritidis group was found in the scrapings but not in the interior of the sausage while in one sample it was present in both.

6. Proteus vulgaris was present in three of the seven samples of scrapings.

Samples 9, 10, 11, and 12 were treated according to the methods of Rommeler and Komma for the isolation of B. paratyphosus, in addition to the routine method. It was found that after digestion for forty-eight hours one drop of the solution produced such an overgrowth that dilution was necessary to distinguish individual colonies. As there seemed to be no advantage by this method over that of Endo while it was more difficult to employ, it was discontinued.

Brilliant Green.—Brilliant green has been used in routine according to the methods described by Torrey for the isolation of members of the enteritidis group. The reaction of the media has been varied from +.2 to +.5 and the amount of the brilliant green from .15 to .25 cc. of 1 per cent. aquous solution added to 10 cc. of broth. In two of the nine cases where enteritidis group

organisms have been isolated, they have been isolated by this means. The reaction and amounts of green added within the limits employed produced little difference. Seven times enteritidis group organisms were obtained from Endo but failed to develop in the brilliant green while B. fecalis, B. coli and Proteus survived at the end of twenty-four hours in four, three and two cases respectively. In Sample five all other varieties of organisms were killed but a member of the streptothrix group. In about 60 per cent. of the samples the brilliant green tubes were sterile at the end of twenty-four hours.

The following organisms have been isolated by the methods described above from the thirty-four samples: B. coli, thirty times; Proteus vulgaris, eleven times; B. paracoli (organism resembling B. paratyphosus morphologically and culturally but not agglutinated by either paratyphoid or enteritidis serum), nine times; B. fecalis, eight times; yeast, eight times; streptococcus, five times; Staph. aureus, two times; and M. tetragenous, a streptothrix, B. intestinalis, B. coli anærogenes, Proteus fluorescens and Staph. albus, once each. The presence of intestinal organisms in so many cases is possibly indicative of unsanitary and careless methods of manufacture but a more extended study would be necessary to determine the significance of these forms. Proteus vulgaris, which was present in one third of the samples, might indicate that old meats in which decomposition had begun were used but in the absence of control tests on known fresh meats for the presence of this organism, should not be given too much importance.

Sulfites.—Samples 22–34 were tested for the presence of sulfites. Five to ten grams of the meat to be tested were placed in an Erlenmeyer flask of 150 cc. capacity, two or three grams of finely granulated C. P. zinc added and then about 30 cc. of strong C. P. HCl poured over the mixture. Controls were always run parallel with the samples and a distinct silvery-black mirror on a filter paper soaked in lead acetate and held over the mouth of the flask five minutes, was considered a positive reaction for the presence of sulfites. A faint gray-black discolorization will generally be obtained from sausages free from sulfites at the end of five minutes but there is never seen the intense black mirror shown by samples to which the preservative has been added. By this means seven of the thirteen samples were shown to contain sulfites, five contained none and one was doubtful. Although sulfite tests were not carried out on Samples 1–21, fifteen samples obtained from the same shops subsequently were examined. Of these samples, three only contained sulfites. Samples 29 and 34, manufactured by the same packing house but obtained from different shops, contained no sulfites, while Samples 30 and 33 manufactured by a different firm, both contained a large amount of sulfites. The samples containing this preservative appeared to have no fewer bacteria per gram than those without the preservative, although the meat might have been originally of poorer quality and the

bacterial count held low by the presence of sulfites.

Starch Adulteration.—Each of the thirty-four samples was examined microscopically for starch adulteration. In samples containing more than 5 per cent., the starch could readily be detected by the eye and taste and gave the sausage a granular appearance. The sausage was rubbed over a microscopic slide and examined fresh to determine if possible the kind of starch granules present. Then Lugol's solution was added and allowed to remain on the slide for a minute and the preparation examined for the presence of the blue-stained starch granules. From the macroscopic and microscopic examination a rough estimate was made of the per cent. of starch added. It must be borne in mind that the pepper used for seasoning contains normally 35–45 per cent. of starch and dextrin and may give a somewhat similar appearance to other starch in stained preparation. It may also happen that the pepper itself may be adulterated with buckwheat middlings or other starchy substances. Cornstarch was very commonly used in a very finely ground condition. It was present in 19 of the 34 samples or in 56 per cent. of all. In 26 per cent. of the samples, 5 per cent. or over was used. It was interesting to note that starch was present in 77 per cent. of the thirteen samples from the poorer districts and in only 38 per cent. of the samples from the more sanitary shops, and that the price per pound in these districts was 13–15 cents and 18–25 cents respectively. In other words the customers of the west side shops are buying starch while the customers of the shops in the better residence districts are buying meat. In the samples that contained starch from the latter district, the per cent. was generally much lower than in samples of the west side as may be seen by reference to Table 1.

Influence of Cooking.—Six samples of pork sausage have been obtained and cooked in various ways in the laboratory to determine the effect of cooking on the bacterial count. It has been the purpose to cook the sausages as nearly as possible as they are cooked in the home. The methods and thoroughness of cooking varies greatly in different homes. This fact has made it desirable to vary the time and method of cooking. A sample of the uncooked sausage was always run in parallel in order to determine the efficiency of the cooking. The sample from the cooked sausage was always taken from the interior after splitting the sausage open under aseptic conditions. Small pork sausages in link form were employed in all cases. It was found in general that cooking destroyed a very large per cent. of the bacteria; and that extra well-cooked sausage in two of the samples were sterile. The detailed results with the conditions of cooking are shown in Table 2. The efficiency of cooking will be seen to vary only within the narrow limits of 93.3 per cent. in Sample 3 to 100 per cent. in Sample 2.

Four samples of sausage cooked in restaurants were obtained and brought directly to the laboratory to be examined as a control on the efficiency of ordinary restaurant cooking. The methods of examination were the same

TABLE 2.

Sample No.	How prepared.	Bacteria per gram 24 hours at 37°C.	Bacteria per gram 48 hours at 20°C.
1	(a) Uncooked	10,500	813,000
	(b) Let simmer in water 10 min. Fried in lard (cold at start) 15 minutes	500	0
	(c) Let simmer in water 10 min. Fried in lard (cold at start) 20 minutes	300	0
2	(a) Uncooked	47,500	929,000
	(b) Let simmer in water 10 min. Fried in lard (cold at start) 10 minutes	0	0
	(c) Let simmer in water 10 min. Fried in lard (cold at start) 15 minutes	0	0
3	(a) Uncooked	33,000	5,700,000
	(b) Boiled in water 20 minutes	31	190
	(c) Boiled in water 30 minutes	0	105
4	(a) Uncooked	55,000,000	80,000,000
	(b) Boiled in water 15 minutes	3,300	200
	(c) Boiled in water 20 minutes	130	0
5	(a) Uncooked	110,000	47,700,000
	(b) Fried in hot lard over asbestos 10 minutes	7,300	100
	(c) Fried in hot lard over asbestos 15 minutes	60	60
6	(a) Uncooked	950,000	132,000,000
	(b) Fried in hot lard over wire gauze 8 minutes	70	200
	(c) Fried in hot lard over wire gauze 12 minutes	0	0

as described above. A small amount of the interior contents being carefully taken and emulsified in sterile water for plating. The results as will be seen vary widely, from an absolutely sterile sample, 3, to one containing 8,000 bacteria per gram. The detailed results are seen in Table 3.

The necessity for the proper sanitary handling of sausage in its manufacture and distribution is self-evident. It is probable that intestinal bacteria

TABLE 3.

Sample No.	Bacteria per gram on 1.5 per cent. glycerin agar (neutral).	
	37°C. for 24 hours.	20°C. for 48 hours.
1	55	205
2	61	0
3	0	0
4	1,075	8,000

enter during the manufacture and that the method of subsequent handling is responsible for the large number of bacteria that develop at 20° C. This fact is illustrated by one sample, No. 10, which was brought directly from the farm where it was ground under ordinary farm conditions. The 20° count was unusually low, 650 per gram.

From the work described in this paper the following conclusions may be drawn:

1. The number of bacteria per gram of sausage varies so widely that little importance can be attached to the bacterial count alone. Many factors, such as the precautions used in manufacture, proper handling in the shops, and the presence of preservatives may influence the count greatly.

2. Skins used as casings, if properly prepared, cannot be considered to increase the bacterial count or the danger from pathogens.

3. Brilliant green as an aid in the isolation of the enteritidis group has proved of limited value only.

4. B. coli is commonly present in sausages. Organisms biologically related to but not identical with the enteritidis group were present in 25 per cent. of the samples and Proteus vulgaris in 33 per cent. of them.

5. Sulfites were present in 54 per cent. of the west side samples and in 20 per cent. of the samples later obtained from the more sanitary shops.

6. Corn starch was found in many samples in amounts varying from 2–12 per cent. Fifty-six per cent. of all samples contained some starch.

7. Ordinary cooking is effective in destroying a large per cent. of the bacteria present.

I desire to express my appreciation to Professor Edwin O. Jordan for valuable suggestions in this work.

PROPOSED MEDICAL CONSOLIDATION IN NEW YORK.

A plan to merge the health department, the Department of Charities, and Bellevue and Allied Hospitals into a single Department of Social Service under one head recommends itself, according to the *Evening World* for November 5, as a businesslike, common sense step toward setting the municipal corporation on a new basis of economy and efficiency.

These three departments handle over $9,000,000 a year. Their work is so closely allied, particularly in the case of the health and charities departments, that one bureau is constantly duplicating the inquiries and remedial measures of another. If they were consolidated their agents and investigators could work together on the same cases, administering relief with the least possible waste of time and money. Moreover, a single head could purchase at a considerable saving the millions of dollars' worth of supplies which these departments now buy separately.

To taxpayers the proposal is welcome, not only for the specific saving it contemplates but also because it should lead to a general scrutiny of city departments with an eye to consolidation, concentration, and increased efficiency. The suggestion has been made that combining the Department of Bridges with the Department of Docks would save the city half a million each year; also that municipal expenses could be reduced at least $250,000 by abolishing the commissioner of accounts, much of whose work could be as well or better done in the comptroller's office.

It is thus that the executive heads of any private corporation set to work to get results. The city hopes it at last sees the beginning of just such a program.—*New York Medical Journal.*